# An Analysis on Costs and Benefits of the No.1 Bayint Naung Bridge (1989/90- 2014/15)

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## Abstract

Within Yangon City, the No.1 Bayint Naung Bridge is one of the infrastructure projects implemented since the late 1990s. This study aims to examine mainly the monetary benefits as well as other economic and social advantages gained from the No.1 Bayint Naung Bridge in Yangon. To analyze costs and benefits of the Bridge, financial costs and benefits from the side of public sector are taken into consideration. Net Present Value Method, Benefit-Cost Ratio Method and Pay- back Period Method are used. From the NPV analysis, it was found that the bridge project is worth implemented. Result from Cost Benefit Analysis shows that total benefit is greater than total construction cost, so the project was cost effective. Pay-back period method also shows that it takes to recover.

Key Words: monetary benefits, costs and benefits analysis, net present value method, benefit - cost ratio method and pay-back period method

## Introduction

In developing world, construction of roads and bridges are being prioritized to facilitate efficient transportation and supporting the emerging markets and commercial activities. Ex-post assessment is also needed for measuring the economic and social benefits of the implemented projects. Being an emerging economy of Southeast Asia after 2011, Myanmar also needs to assess the monetary and other benefits of its infrastructure projects for enhancing its economy in the future.

## Rationale of the Study

Like other developing countries, development of transport infrastructure becomes more crucial in Myanmar after 2011 with significant political and socioeconomic reforms. The development of road infrastructure including bridges can enhance both internal and external flow of goods, smooth the transportation of people, and reduce traffic congestion and narrowing the development gap. Within the Yangon City, numerous infrastructure projects have been implemented and the No.1 Bayint Naung Bridge is one of them. The No.1 Bayint Naung Bridge crosses over Hlaing River to connect the satellite township of the Yangon City, Hlaing Thar Yar Township and urban area of Mayangon Township. By analyzing cost and benefit analysis, its monetary costs and benefits can be explored and can be able to utilize its experience as best practice in future infrastructure development projects.

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### Objective of the Study

The main objective of this study is to examine mainly the monetary benefits, economic and social advantages gained from the No.1 Bayint Naung Bridge in Yangon.

### Scope of the Study

This study analyzes the advantages of No.1 Bayint Naung Bridge from the period of initiating the project to present, i.e. from 1989-90 to 2014-15. In analyzing the advantages of the bridge, economic analysis, especially the financial costs and benefits from the side of the public sector are taken into consideration.

### Method of the Study

Both descriptive and analytic approaches are used in this study. Former approach is used in portraying the background, plan and implementation processes of the Bridge. The latter, analytical approach is used in calculating the financial/ commercial costs and benefits of the Bridge within the 25 year period. Specifically, analyses are based on the methods of Net Present Value, Benefit-Cost Ratio (BCR) and Pay-back Period.

### Organization of the study

This study is organized with four main sections. The first section is the introductory part. In second section, methods of the study are presented. Section three is an analysis on advantages of No.1 Bayint Naung Bridge for 25 year period. Section four is the conclusion with findings and suggestion for future Myanmar infrastructure projects.

## Methods

### Major Approaches Used in the Study

There are numerous approaches to evaluate financial, economic and social consequences. Among them, **Cost Benefit Analysis (CBA)** is a method for assessing the net benefits accruing to society as a whole as a result of a project, programme or policy. The rationale of cost-benefit analysis is to provide a consistent procedure for evaluating decisions in terms of their consequences.[2] It includes estimating costs and benefits which are un-priced and not the subject of normal market transactions but

[2] personal.lse.ac.uk/sternn/040NHS.pdf

which nevertheless entail the use of real resources. [3] In conducting CBA, discounting provides a way to compare the monetary value of costs and benefits received in different time periods to present values. Selecting an appropriate discount rate is important because different rates can produce different cost-benefit results and affect policy recommendations.

In order to assess the investment profitability of a project, various approaches can be used as basis which includes Simple rate of return, Pay-back period, Net present value and internal rate of return. In analyzing the costs and benefits of No. 1 Bayint Naung Bridge, pay-back period and net present value method is applied.

**(a) Pay-back period method**

This method measures the time needed for a project to recover its total investment through its net cash earnings. Therefore, the pay-back period is the number of years during which a project will accumulate sufficient net cash earnings to cover the amount of its total investment. It is given by the expression

$$I = \sum_{t=0}^{p} F_t + D_t$$

where

I = total investment, p = pay-back period,

Ft = annual net profits in the year t, Dt = annual depreciation in the year t,

Ft + Dt = annual net cash earnings in year t

If a single project is being evaluated, it will be accepted for implementation in case P <Pm, where Pm is a cut-off pay-back period adopted by the decision maker. If p is greater than $p_m$, the project in question will be rejected

***Discounted Payback Period***

This is a capital budgeting procedure used to determine the profitability of a project. In contrast to an NPV analysis, which provides the overall value of a project, a discounted payback period gives the number of years it takes to break even from undertaking the initial expenditure. Future cash flows are considered are discounted to time "zero." In discounted payback period, it has to calculate the present value of each cash inflow/outflow taking the start of the first period as zero point. The discounted cash inflow/outflow for each period is to be calculated using the formula:

[3] www.finance.gov.au/sites/default/files/Intro_to_CB_analysis.pdf

$$\text{Discounted Cash flow} = \frac{\text{Actual cash flow}}{(1+i)^n}$$

Where,

**i** is the discount rate; **n** is the period to which the cash flow relates.

Usually the above formula is split into two components which are actual cash inflow/outflow and present value factor (i.e. $1 / (1 + i)^n$ ). Thus discounted cash flow is the product of actual cash flow and present value factor. The rest of the procedure is similar to the calculation of simple payback period except that it has to use the discounted cash flows as calculated above instead of actual cash flows. The cumulative cash flow will be replaced by cumulative discounted cash flow.

$$\text{Discounted Payback Period} = A + \frac{B}{C}$$

Where,

**A** = Last period with a negative discounted cumulative cash flow;

**B** = Absolute value of discounted cumulative cash flow at the end of the period A;

**C** = Discounted cash flow during the period after A.

**(b) Net present value method**

The net present value of a project is defined as the difference between the present values of its future cash inflows and outflows. This means that all annual cash flows should be discounted to the zero point of time (the start of the implementation) at a predetermined discount rate. This is given by the expression

$$NPV = NCF_0 + (NCF_1 \times a_1) + (NCF_2 \times a_2) + \dots + (NCF_n \times a_n)$$

where

NPV = net present value of a project,

NCF = net cash flow of a project in years 0, 1, 2, …, n

a = discount factor in years 1, 2, …, n, corresponding to the selected rate of discount.

Similarly, following formula can also be used.

$$NPV = \sum_{t=0}^{n} (CI - CO)_t a_t$$

where

n = a sum total for the whole lifetime of the project from year 0 to year n,

$CI_t$ = cash inflow in the year t, COt = cash outflow in the year t,

$a_t$ = discount factor in the year t corresponding to the selected rate of discount. The project's net present value, other things being equal, increases with larger CI and number of years, but decreases with a higher discount rate and CO.

A project is commercially acceptable if its present value is greater than or at least equal to zero. If NPV is positive, the project would be worthwhile and should be accepted, vice-versa. If NPV is equal to 0, the project neither adds nor subtracts value. When comparing mutually exclusive alternatives, the alternative that yields the highest NPV would be chosen.

**(c ) Benefit- Cost Ratio Method**

A benefit-cost ratio (BCR) is an indicator, used in the formal discipline of cost-benefit analysis that attempts to summarize the overall value for money of a project or proposal. The ratio (BCR) takes into account the amount of monetary gain realized by performing a project versus the amount it costs to execute the project. The higher the BCR, the better the investment is. A project is potentially worthwhile if the BCR is greater than 1. This means that the PV of benefits exceeds the PV of costs.

$$BCR = \frac{PV_{Benefits}}{PV_{Costs}}$$

Where:

$$PV_{Benefits} = \sum_{n=0}^{N} \frac{B_n}{(1+r)^n}$$

$$PV_{Costs} = \sum_{n=0}^{N} \frac{C_n}{(1+r)^n}$$

**An Analysis on Advantages of the No.1 Bayint Naung Bridge**

To analyze the construction of No.1 Bayint Naung Bridge from the financial point of view, Net Present Value, Benefit-Cost Ratio and Pay-back Period Methods are used.

**Construction Cost of No.1 Bayint Naung Bridge**

The construction cost for the bridge was 222 million kyats in domestic currency and 28.40 million kyats in foreign currency. So, that bridge was built at the total cost of above 250 million kyats, which was spent on construction materials, labor charges and to pay the tax on the machinery and equipment imported from foreign countries. This amount may be divided into the following categories.

| **Types of Work** | **US $** | **=** | **Kyats in millions** |
|---|---|---|---|
| (1) Steel Frame | 3410000 | = | 21653500 |
| (2) Electrical equipment | 59782 | = | 379615.7 |
| (3) Commission fees | 13412 | = | 85166.2 |
| (4) General Cost | 16806 | = | 106718.1 |
| | **3500000** | | **22225000** |
| Sponsored (Swiss Frances) | | | 6175000 |
| Total Costs | | | **28400000** |

Source: Completion Report of the Number 1 Bayint Naung Bridge Project

** The official exchange rate between kyat and US $ was 1US $ = 6.35 kyats in (1989-1990)

Public Work has to incur cost for the domestically produced construction materials, wages and salaries, custom duties for imported materials, machinery and equipment from foreign countries. A total of 222.1 million kyats was emerged for the construction of the bridge and this amount may be divided into the following categories.

| (1) Construction of the bridge | Kyats in millions |
|---|---|
| (a) Pre-engineering works | 0.2 |
| (b) Subsidiary works | 10.3 |
| (c) Main bridge | 95.6 |
| (d) Machines, expertise charge and Approach pier | 107. 5 |
| | 213.6 |
| (2) Custom duties for imported machinery and materials | 8.5 |
| | 222.1 |

Source: Public works, Finance Department

The Ministry of Construction, Public Works disbursed the total budget of Kyats 250 million into 6 times within the budget year 1989-90 and 1994-95 through annual based. In 1989-90, the initial budget of Kyats 13.78 million was disbursed. Then, Kyats 20 million was paid out in 1990-91. In 1991-92, Kyats 23.66 million was

distributed for the construction of bridge. In 1992-93, 1993-94 and 1994-95 budget years, Kyats 41.76 million, Kyats 50.89 million and Kyats 99.91 million were disbursed respectively.

**The Benefits of Building No. 1 Bayint Naung Bridge**

By building a bridge, advantages of the financial/commercial profit, are received from the charge of the vehicles passing through the bridge. Before the No.1 Bayint Naung Bridge was constructed the annual average daily traffic (AADT) was (50) vehicles from the west Hlaing River to Nyaungdon. After the No.1 Bayint Naung Bridge near Insein had been constructed, it would save about 8 hours. Transporting passengers and the goods by water way also would dip to 50%. Thus, the number of the vehicles passing through the bridge might become over (360) vehicles.[4] The estimated number of the average vehicles would be 700 per day after the construction of the Yangon-Pathein road had been completed.[5]

Toll charges are collected for crossing the bridge since 1994-1995 at the ordinary rate of flying over. Between (1-12-1997) to (31-3-2004), the toll charges were collected by the staffs of the Public Works, Yangon Division and the North District. But, from the date (1-4-2004) onwards, toll charges were collected by the auction winner, at the same rate of ordinary up to (30-9-2011). The toll rates for various kinds of vehicles are as follows.

**Table 4.1 Toll Rate for ordinary Bridges No.1 Bayint Naung Bridge (1997-2011)**

| No. | Kinds of Vehicles | Toll Rate (Kyat) |
|---|---|---|
| 1 | Motorcycles, Pony Cards, Trollergies | 5 |
| 2 | Vehicles (2 tons and below, others, Private Cars) | 30 |
| 3 | Hilux Buses | 40 |
| 4 | Buses (2 tons and below) | 40 |
| 5 | Vehicles (2 tons and below 5 tons) | 60 |
| 6 | Buses (5 tons and above) | 110 |
| 7 | Big Vehicles (5 tons and above) | 150 |
| 8 | Trucks (20 tons) | 150 |

Source: Toll gate office, Bayint Naung Bridge (2015)

[4] Ministry of Construction, Public Works, (1988), Preliminary report on Hlaing River Bridge Construction Project, Yangon

[5] Ministry of Construction, Public Works, (1994), Completion report of the N0.1 Bayint Naung Bridge, Yangon

No toll is charged for military vehicles, police vehicles, and other vehicles on official duty and for ambulances and the vehicles going to Shwe Ta Kaw Cemetery. Weekly Revenues from Toll Charge are shown in table below.

**Table 4.2 Revenue from toll on a Weekday and Weekends (3-3-1997- Moday) and (9-3-1997- Sunday)**

| Particulars | Weekday (Kyats) | | | Weekends (Kyats) | | |
|---|---|---|---|---|---|---|
| | Rate | Number | Revenue | Rate | Number | Revenue |
| Vehicles (5 tons and above) | 100 | 162 | 16200 | 100 | 178 | 17800 |
| Vehicles (2 tons and 5 tons above) | 35 | 99 | 3465 | 35 | 90 | 3150 |
| Vehicles (2 tons and above) | 25 | 1110 | 27750 | 25 | 1149 | 28725 |
| Motorcycles | 5 | 70 | 350 | 5 | 80 | 400 |
| Passenger buses | 10 | 25 | 250 | 10 | 24 | 240 |
| **Total** | | **1466** | **48015** | | **1466** | **50315** |

Source: Toll gate office, Bayint Naung Bridge (2015)

Then, the toll charges were amended according to the level D of the planed bridge starting from the date October 1, 2011. An auction winner is the Oriental Highway Company. New Toll Rate for ordinary Bridges No.1 Bayint Naung Bridge From (1-10-2011) to present time is illustrated in following table.

**Table 4.3 New Toll Rate for ordinary Bridges No.1 Bayint Naung Bridge From (1-10-2011) to Present (Kyats)**

| No. | Kinds of Vehicles | Level D* |
|---|---|---|
| 1 | Bicycles | - |
| 2 | Motorcycles, pony carts | 10 |
| 3 | Trolleries, 3 wheeled motor cycle for passengers | 20 |
| 4 | Vehicles under 20 tons (line buses), private cars, taxis, mini buses, etc. | 50 |
| 5 | Line buses (from 2 to 5.5 tons), Hilux, light trucks, dianas, canters, line buses (9 persons above), trolleries, 3 wheeled vehicles (for load) | 100 |

| No. | Kinds of Vehicles | Level D* |
|---|---|---|
| 6 | Trucks (2 tons below) (for load) | 125 |
| 7 | Vehicles (2- 5.5 tons) (for load) light trucks (length of frame under 15') | 150 |
| 8 | Big vehicles (5.5 tons to 16 tons)(for passengers), and big air-con buses | 200 |
| 9 | 6 wheeled mini trucks (passengers +load) (5+5), 10 tons | 215 |
| 10 | 6 wheeled mini trucks (passengers +load) (6.5+6.5), 13 tons | 225 |
| 11 | 6 wheeled big trucks (passengers +load) (8+8), 16 tons | 250 |
| 12 | 10 wheeled big trucks (passengers +load) (10.5+10.5), 21 tons | 300 |
| 13 | 12 wheeled big trucks(passengers +load) (12.5+12.5), 25 tans | 350 |
| 14 | 14 wheeled big trucks with carrier (passengers +load) (14+20), 34 tans | 550 |
| 15 | 18 wheeled big trucks with carrier (passengers +load) (15+31), 46 tans | 800 |
| 16 | 22 wheeled big trucks with carrier (passengers +load) (16+39), 55 tans | 1000 |
| 17 | If the big trucks mentioned from No.(1) to (16) passing through the bridges were empty. | 250 |

Source: Toll gate office, Bayint Naung Bridge (2015) *Toll Rate for 180 feet and 1000 feet below

Trucks carry the load more than the limited weight will be fined 10 times. The purpose of penalizing on heavy machines is to prevent overloaded vehicles causing damage to Bridge. Table below shows the revenue from toll for a typical weekday and weekend.

This table presents the sample revenue collected on weekday (i.e. 3-11-2014 – Monday) and sample revenue collected on weekend (i.e. 1-11-2014 –Saturday). These two dates are chosen as their daily revenues did not deviate much to that of average daily revenues. Based on the data on November 2014, average revenue from toll on weekday earned amounted to Kyats 2017245 and on weekend about Kyats 1500592 on the average. Therefore, total revenue from toll for a year would amount to about 479.2 million kyats.

**Table 4.4 Revenue from toll in a Weekday and Weekends (3-11-2014- Monday) and (1-11-2014- Sunday) (Kyats)**

| Particulars | Weekday | | | Weekends | | |
|---|---|---|---|---|---|---|
| | Rate | Number | Revenue | Rate | Number | Revenue |
| Vehicles under 20 tons (line buses), private cars, taxis, mini buses, others | 50 | 13856 | 692800 | 50 | 12598 | 629900 |
| Line buses (from 2-5.5 tons), Hilux, light trucks, dianas, canters, line buses (9 persons above), trolleries, 3 wheeled vehicles (for load) | 100 | 1689 | 168900 | 100 | 1650 | 165000 |
| Trucks (2 tons below) (for load) | 125 | 194 | 24250 | 125 | 165 | 20625 |
| Vehicles (2 tons to 5.5 tons) (for load) light trucks (length of frame under 15 feet) | 150 | 1052 | 157800 | 150 | 1122 | 168300 |
| 6 wheeled mini truck (passengers+load) (5+5), 10 tons | 215 | 1959 | 421185 | 215 | 1214 | 261010 |
| 6 wheeled big trucks (passengers+load) (8+8), 16 tons | 250 | 128 | 32000 | 250 | 215 | 53750 |
| 14 wheeled big trucks with carrier (passengers+load) (14+20), 34 tans | 550 | 952 | 523600 | 550 | 638 | 350900 |
| **Total** | | **19830** | **2020535** | | **17602** | **1649485** |

Source: Toll gate office, Bayint Naung Bridge (2015)

**Financial Analysis of the No.1 Bayint Naung Bridge**

Analysis is made based on the methods of NPV, CBA and Pay-back Period.

***Net Present Value Method***

The basic points in calculating include

(1) Construction cost (cash outflow) for Investment = 250 million kyats
(2) Construction period = 6 years
(3) Maintenance cost = (1) 0.05 million kyats per year (1995-96 - 2005-06)
(2) 180 million kyats for 2 years (2006-07 - 2007-08)
(3) 200 million kyats for3 years (2008-09 - 2015-16)
(4) Interest rate (per years) = 13% (from CBM)[6]
(5) Revenue (cash inflow) after construction of the bridge = 2.47 million kyats

The Net Present Value Method (NPV) was calculated designating 2015-2016 as zero point and counting back to the starting date. Therefore NPV are not discounted, but inflated values according to interest rate 13%. Because the (NPV) (3616.901) is positive during the period between completion of bridge construction and 2015-2016, i.e. 22 years, the project earns more than the 13% interest rate of return. Accordingly, the No.1 Bayint Naung Bridge project is worth implemented.

***Benefit-Cost Ratio Method (BCR)***

A project is potentially worthwhile if the BCR is greater than 1. This means that the PV of benefits exceeds the PV of costs. Under this decision rule, if the alternatives are mutually exclusive, the alterative with the highest BCR would be chosen. The bridge's benefit cost ratio of total benefit from road and bridge users and total construction cost.

For the No.1 Bayint Naung Bridge construction project, at 13% interest rate of the Central bank of Myanmar convention, the total profit and cost were (5493.8122 ) million kyats and (5023.3954 ) million kyats for (17) years after construction has been completed ( from 1994-1995 to 2010-2011 ), by calculating Pay-back period method. Benefit – Cost Ratio $= \frac{PV_{benefit}}{PV_{cost}}$

$$B/C = \frac{5493.8122}{5023.3954} = 1.0936 > 1$$

Consequently, the benefit cost ratio is greater than one, which means total benefit is greater than total costs. From the financial point of view, it was cost effective. By looking at the financial situation, the Bridge generates positive financial outcome within the two decades. As a result, transportation, residents, hotels, markets, hospitals, cemeteries are improved within the region of bridge.

[6] http://www.cbm.gov.mm

***Pay-back Period Method***

By the end of year (16) in 2009-2010, the No.1 Bayint Naung Bridge has recovered (4710.7772) million kyats cumulative cash inflow of the (4900.5602) million kyats cumulative cash outflow, so it is only (4900.5602-4710.7772=189.7830) short of payback. Because the Vehicles Operation Cost (VOC)/Revenue (cumulative discounted cash inflow) in 2010-2011 as year (17) is (5493.8122) million kyats, the No.1 Bayit Naung Bridge had recovered more than the initial construction cost. Therefore, the pay-back period was somewhere between (16) and (17) years. Assuming that the cash flow occurs evenly throughout the (17) years, the pay-back period is calculated as follow:

$$\text{Pay-back period} = 16\text{years} + \frac{189.7830 \text{ (amount needed to complete recovery in year 17)}}{5493.8122 \text{ (revenue/cash inflow in year 17)}}$$

$$= 16.0345 \text{ Years} = 16\text{years and } 12 \text{ day}$$

The pay-back period is (16.0345) years for bridge life. It takes to recover, in net cash flows and cash outflows. Thus, Pay-back period of the bridge was 2010-2011 fiscal year, after completing the construction of this bridge. From financial point of view, benefits have started to gain since 2010-2011 fiscal year. It was found that the construction project was analyzed and constructed by calculating pay-back period method from the financial point of view or can be said as attaining the situation of cost recovered.

## Conclusion

From the analyses, it was found that construction of No. 1 Bayint Naung Bridge is financially beneficial. Income from No.1 Bayit Naung Bridge had increased because tolls had been received from inauguration of the bridge. When calculating the Net Present Value Method from bridge project, the NPV (3616.901) is positive within 22 years, between the year of completion of bridge construction and 2015-2016. Therefore, the project earns more than the 13% interest rate of return. It was also found that the Cost Benefit Ratio is 1.0936, i.e. greater than 1. This means that total benefit is greater than total construction cost at interest rate 13% for 17 years after the bridge has been constructed (from 1994-1995 to 2010-2011) by calculating pay-back period method. As a result, the project was cost effective. In calculating the pay-back period at 13%, it was found that the pay-back period was 16.0345 years (or 16 years and 12 days) after completion of bridge construction; it takes to recover, in net cash flows and cash outflows. Usually, the life span of a bridge is set as 40 years. Based on the pay-back analysis, pay-back period of the bridge was 2010-2011 fiscal year, i.e. 16.03 years after completing the construction of this bridge. From financial point of view, benefits have started to gain since 2010-2011 fiscal year.

Apart from financial benefits, economic and social benefits have been gaining by people residing and carrying out business activities around the Bridge as well as those from Yangon and Ayeyarwady Regions of Myanmar. Potential social benefits from this Bridge include increase in the socio-economic development in the connected region with the bridge, save transportation charges and decrease in commodity price, smooth, secure and better transportation for the people, greater development for the people who reside in Ayeyarwaddy Region, Rakhine state and other parts in Myanmar. Moreover, engineers and their crew can gain expertise in building bridges technology. These advantages could not be measured in monetary benefit. The Bridge serves as the major east-west linkage for the communication of national transport network. Improving efficiency of transportation for passengers and cargo would be because of crossing Hlaing River and almost all over the delta region in Ayeyarwaddy.

From the analysis on construction of No.1 Bayint Naung Bridge, the sustainability of gaining financial benefits throughout the lifespan of the bridge is essential. Department of Audit should survey and collect data continuously on the tasks of No.1 Bayit Naung Bridge. Maintenance work should be done in accord with the time because the piles are being eroded by the river water. Moreover, as the river bed becomes thicker than the past, laying stones or some maintenance work should be done in accordance with the time to sustain and safe for the users. In addition, continuous maintenance must be conducted for steel structures. The height of the piles should be checked at all times. Maintenance work team should be formed ahead and they should do it without failure if there is something wrong in bridge.

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